PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-095197

(43)Date of publication of application : 09.04.1999

(51)Int.Cl. G02F 1/1333
G02B 3/00
G02F 1/13
G02F 1/1335
G02F 1/136
G09F 9/00

(21)Application number : 09-253845

(22)Date of filing : 18.09.1997

(71)Applicant : RICOH OPT IND CO LTD

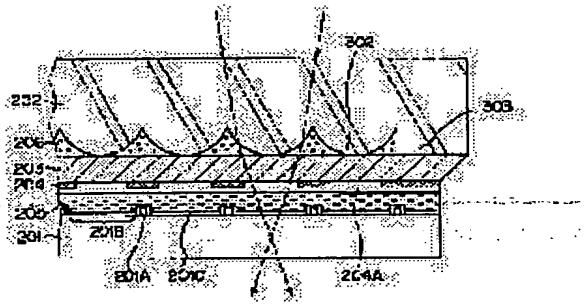
(72)Inventor : UMEKI KAZUHIRO
SATOU MASAHISA
NAKITA SATOSHI
YAMAZAKI YOSHIYUKI

(54) LIQUID CRYSTAL DEVICE FOR LIQUID CRYSTAL PROJECTOR AND COUNTER SUBSTRATE FOR LIQUID CRYSTAL DISPLAY

(57)Abstract:

PROBLEM TO BE SOLVED: To embody a counter substrate of a structure capable of effectively lessening the occurrence of chipping, cracking, peeling, etc., at the time of disconnecting in the production process of liquid crystal devices.

SOLUTION: This liquid crystal device is constituted by integrating a refractive surface array substrate 202 which is a counter substrate to be arranged on a photoirradiation side and is arrayed and formed with microrefractive surfaces 302 having a light converging function corresponding to the individual pixels at a TFT substrate 201 on one surface and a plane substrate 103 which is formed with black matrix apertures 204 corresponding to the array arrangement of the refractive surfaces and consists of a transparent material having the coefft. of thermal expansion approximately equal to the coefft. of thermal expansion of the refractive surface array substrate 202. Spacer parts 303 for maintaining the spacing between the refractive surface array substrate 202 and the plane substrate are formed in the outer peripheral parts of the array arranging regions of the surface of the refractive surface array substrate 202 on the side formed with the array of the refractive surface in such a manner that the size of the spacing is larger than the height of the microrefractive surfaces and that the outer peripheral parts of the spacer parts 303 constitute part of the outer peripheral end surface of the counter substrate.



LEGAL STATUS

[Date of request for examination] 03.09.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] In the liquid crystal device for liquid crystal projectors, a liquid crystal layer is pinched with a TFT substrate. The refracting interface array substrate which are the opposite substrate arranged at an optical exposure side, and the minute refracting interface with an optical focusing function was made to correspond to each pixel in a TFT substrate, and carried out array formation on one side at the shape of an array, It is arranged in the near field in which the array of the refracting interface of this refracting interface array substrate was formed. The black matrix aperture corresponding to the array array of the above-mentioned refracting interface is formed. The above-mentioned refracting interface array substrate and a coefficient of thermal expansion are in abbreviation etc. by carrying out, and it comes to unify the flat-surface substrate by the transparent material. The near field in which the transparent electrode film was formed in one outside flat surface of the unified substrate, and the array of the refracting interface of the above-mentioned refracting interface array substrate was formed, the spacer section for maintaining the gap of a refracting interface array substrate and a flat-surface substrate at the periphery section of an array array area -- the magnitude of the above-mentioned gap -- the above -- so that it may become more than the height of a minute refracting interface. And the opposite substrate for liquid crystal devices characterized by the periphery section of the above-mentioned spacer section forming so that a part of periphery end face of an opposite substrate may be made.

[Claim 2] The counterelectrode for liquid crystal devices characterized by each refracting interface formed in the refracting interface array substrate being the micro lens of a convex or concave in the counterelectrode for liquid crystal devices according to claim 1.

[Claim 3] 45 abbreviation - 70 abbreviation, and a beveling residue are the opposite substrate for liquid crystal devices with which it is characterized by for a flat-surface substrate being thickness:20micrometer-250micrometer in the opposite substrate for liquid crystal devices according to claim 1 or 2, performing beveling to the periphery end face, and the angle of chamfer of a chamfer being 15 micrometers or more of abbreviation.

[Claim 4] The opposite substrate for liquid crystal devices characterized by arranging a flat-surface plate at a liquid crystal layer side in the opposite substrate claims 1 or 2 or for liquid crystal devices given in three.

[Claim 5] The opposite substrate for liquid crystal devices characterized by inserting the transparent medium which has a predetermined refractive index between a refracting interface array substrate and a flat-surface substrate in the opposite substrate for liquid crystal devices given in 1 of the arbitration of claims 1-4.

[Claim 6] The opposite substrate for liquid crystal devices characterized by a transparent medium filling the gap part between the refracting interface array substrates and flat-surface substrates in the array array area of the array of a refracting interface in the opposite substrate for liquid crystal devices according to claim 5.

[Claim 7] The opposite substrate for liquid crystal devices with which a transparent medium with a predetermined refractive index is characterized by being the adhesives for junction in the opposite substrate for liquid crystal devices according to claim 6.

[Claim 8] The liquid crystal device for liquid crystal projectors which comes to pinch a liquid crystal layer with the opposite substrate and TFT substrate for the liquid crystal devices indicated by 1 of the arbitration of claims 1-7.

[Translation done.]

* NOTICES *
JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the opposite substrate the liquid crystal device for liquid crystal projectors, and for liquid crystal devices.
[0002]
[Description of the Prior Art] An image is displayed on the liquid crystal device which comes to arrange the liquid crystal pixel which can control the transparency condition and cut off state of light individually to two-dimensional, the flux of light is irradiated at this image, and the "liquid crystal projector" which displays an image is known by carrying out projection image formation of the transmitted light on a screen. "TFT-LCD (Thin Film Transistor Liquid Crystal Device)" widely known as the above-mentioned liquid crystal device has composition which pinched the thin liquid crystal layer with one pair of transparent substrates. One side of one pair of substrates is called a "TFT substrate", and while array formation of the TFT (Thin Film Transistor) for impressing the drive electric field over liquid crystal is carried out according to a pixel array, the bus line for driving these [TFT] is formed in the field of the side which touches a liquid crystal layer. The part in which TFT and a bus line are not formed is arranged two-dimensional as "minute opening", and each opening corresponds to a "pixel."
[0003] The substrate of another side which pinches a liquid crystal layer with a TFT substrate is called an "opposite substrate", and the array of the transparent counterelectrode layer to a TFT array and the black matrix layer (opening according to opening corresponding to the above-mentioned pixel "black matrix aperture") which shades the exposure flux of light to TFT or a bus line etc. is formed in the field of the side which touches a liquid crystal layer. Thus, area partial" assigned to "1 pixel of TFT-LCD consists of the part and opening which light penetrates neither by TFT nor the bus line, and the area of opening is order [40% of abbreviation]" to "1 pixel quota area. For this reason, when the parallel flux of light is irradiated at TFT-LCD, it is as small as about 40% of incident light that opening can be penetrated per each pixel, and its use effectiveness of light is bad. In order to raise efficiency for light utilization, the micro lens of a convex is prepared corresponding to each pixel in TFT-LCD, and making the pixel part which corresponds light by each micro lens condense is known.
[0004] By the way, in case you manufacture TFT-LCD, it is separated in a regular dimension and let it be the opposite substrate of one unit (chip), after the above-mentioned opposite substrate makes many substrates arrange on the substrate of a large area, arranging it generally, bundling up many substrates and producing them to one. In the case of this cutting, stress concentration may arise in the "substrate with weak reinforcement" side among the refracting interface array substrate (the array of said micro lens is formed) which constitutes an opposite substrate, and a flat-surface substrate, and "KAKE" and a "chipping" may arise. Moreover, the periphery edge of the flat-surface substrate in an opposite substrate "is beveled" in many cases, and also in case it is this beveling, exfoliation of the layer of the adhesives which join KAKE, a chipping or a refracting interface array substrate, and a flat-surface substrate may generate it. Exfoliation of the layer of these KAKE, a chipping, and adhesives etc. not only bars actuation of a liquid crystal device, but can become the cause which causes the abnormalities of liquid crystal.
[0005]
[Problem(s) to be Solved by the Invention] This invention makes a technical problem implementation of the structure which can mitigate generating of KAKE, a chipping, and adhesives of peeling etc. effectively in the case of the above-mentioned isolation in the manufacture process of a liquid crystal device of an opposite substrate.
[0006]
[Means for Solving the Problem] The opposite substrate of this invention is "an opposite substrate which pinches a liquid crystal layer with a TFT substrate, and is arranged in the liquid crystal device for liquid crystal projectors at an optical exposure side", comes to unify a refracting interface array substrate and a flat-surface substrate, and has the following descriptions (claim 1). That is, the minute refracting interface which has an optical focusing function in a "refracting interface array substrate" makes it correspond to each pixel in a TFT substrate, and array formation is carried out on one side at the shape of an array. A refracting interface array substrate and a coefficient of thermal expansion are in abbreviation etc. by carrying out, and it is an parallel plate by the

transparent material by the transparent material, and a "flat-surface substrate" is arranged in the near field in which the array of the refracting interface of a refracting interface array substrate was formed, has the black matrix aperture corresponding to the array array of a refracting interface formed, and is united with a refracting interface array substrate. The "transparent electrode film" is formed in one outside flat surface (field which touches a liquid crystal layer) of the unified substrate. although "the spacer section for maintaining the gap of a refracting interface array substrate and a flat-surface substrate" is formed in the periphery section of an array array area of the near field in which the array of a refracting interface of a refracting interface array substrate was formed, the magnitude of the above-mentioned gap becomes "more than the height of a minute refracting interface", and, as for this spacer section, the periphery section of the spacer section "makes a part of periphery end face of an opposite substrate" -- it is formed like. By taking such structure, each liquid crystal device will be separated in the part of the "spacer section" of an opposite substrate in the "isolation process" of said manufacture. Since the spacer section has the thickness "more than the height of a minute refracting interface" and fixes with a flat-surface plate through a jointing material for corrugated fibreboard, the mechanical strength in this part becomes large enough, and generating of KAKE or a chipping is effectively controlled in the case of isolation.

[0007] In addition, in order for a case to adjust the optical path length between a refracting interface array substrate and a flat-surface substrate "when the transparence member (called a "middle component") of the shape of sheet metal which has a predetermined refractive index may be prepared and the mechanical strength of a middle component is weak in such a case, in an isolation process, KAKE, a crack, etc. may arise in a middle component. In this case, a middle component should just be cut with the above-mentioned spacer section. In this case, it becomes what the periphery section of a middle component also "makes a part of periphery end face of an opposite substrate for." Thickness of a middle component can be made thinner than other parts in the part pinched with the above-mentioned spacer section and a flat-surface substrate.

[0008] Each refracting interface formed in a refracting interface array substrate has "an optical focusing function", this optical focusing function does not necessarily need to have the function to which image formation of the flux of light is carried out like a positive lens, and a "cone configuration" and a "truncated cone configuration" are possible for it as a configuration. However, in order to raise efficiency for light utilization to the maximum, as for each refracting interface formed in a refracting interface array substrate, it is desirable that it is a "micro-lens side." This micro-lens side can be "a micro-lens side of a convex", and also like invention according to claim 6, when filling the gap parts of a refracting interface array substrate and a flat-surface substrate with "a transparent medium with a predetermined refractive index", and the refractive index of the above-mentioned medium is higher than the refractive index of a refracting interface array substrate, it can be made into "the micro-lens side of concave." That is, a refracting interface can be "the micro lens of a convex or concave" (claim 2).

[0009] 20-250-micrometer about 30-90 micrometers are more preferably suitable for the thickness of a flat-surface substrate. Although it is general that "beveling (taper field which spreads toward a refracting interface array substrate side)" is performed to the periphery end face of a flat-surface substrate of the opposite substrate for liquid crystal devices like the above-mentioned, it is desirable that 45 abbreviation - 70 abbreviation, and "the beveling residue of the "angle of chamfer" of a chamfer" are 15 micrometers or more of abbreviation (claim 3). If it bevels in above "angle of chamfer and amount of beveling", KAKE in the case of beveling, exfoliation of a chipping and a jointing material for corrugated fibreboard, etc. can be prevented effectively. As an external flat surface of the "opposite substrate" like the above, there is the 2nd page, the field (field of the side which is not having the array of a refracting interface formed) of a refracting interface array substrate, and the field of a flat-surface substrate, and the "transparent electrode film" is formed in the field which grows into a liquid crystal layer side between these 2nd page. Thus, although the transparent electrode film may be formed in a refracting interface array substrate side and you may form in a flat-surface substrate side, when it takes into consideration that the refracting interface array substrate tends to become thicker than a flat-surface substrate, and generally does not have so greatly the focusing functions (focal distance etc.) by the refracting interface, that of "arranging a flat-surface plate at a liquid crystal layer side" (claim 4) is desirable. Between a refracting interface array substrate and a flat-surface substrate, "a transparent medium with a predetermined refractive index" can be inserted (claim 5). the above -- a transparent medium can fill "the gap part between the refracting interface array substrates and flat-surface substrates in the array array area of the array of a refracting interface" (claim 6), and the adhesives for junction "can serve as a transparent medium with a predetermined refractive index" in this case (claim 7)

[0010] "The liquid crystal device for liquid crystal projectors" of this invention pinches a liquid crystal layer with the opposite substrate and TFT substrate for the liquid crystal devices indicated by one of the arbitration of above-mentioned claims 1-7, and is constituted.

[0011]

[Embodiment of the Invention] Drawing 1 shows the "liquid crystal device" as one gestalt of implementation of this invention in explanatory view. In the sign 201 in drawing, a "refracting interface array substrate" and a sign 203 show a "flat-surface substrate", and, as for a "TFT substrate" and a sign 202, a sign 205 shows a "liquid crystal layer." TFT201A for driving each pixel and a bus line (not shown) are formed in the field of the side which touches the liquid crystal layer 205 of the TFT substrate 201, and the part which is not covered with these TFT(s)201A and a bus line has become opening 201B as a "pixel." Sign 201C shows the "transparence electric conduction film." The flat-surface substrate 203 which pinches the liquid crystal layer 205 with the TFT substrate 201 is "a transparent parallel plate", the black matrix 204 is formed in the field of the side which touches the liquid crystal layer 205, and transparent electrode 204A is formed of ITO on the black matrix 204. The array array of the micro lens 302 of a convex is formed in the near field which faces the flat-surface substrate 203 at the refracting interface array substrate 202 as a "refracting interface." The refracting interface array substrate 202 and the flat-surface substrate 203 constitute the "opposite substrate" of a liquid crystal device.

[0012] In drawing 1 , incidence of the exposure flux of light is carried out from the flat field (top side of drawing) of the refracting interface array substrate 203, it carries out incidence to each refracting interface 302, and is refracted, opening (black matrix aperture) of the black matrix 204 is passed, the liquid crystal layer 205 is penetrated and opening 201B which is the "pixel" in the TFT substrate 201 is passed.

[0013] the quality of the materials of the refracting interface array substrate 202 and the flat-surface substrate 203 are a process after opposite substrate manufacture, and a heat treatment process, and the refracting interface array substrate 202 and the flat-surface substrate 203 do not exfoliate — as — "coefficient of thermal expansion — abbreviation — equal —." — although things are required, if it is the ingredient with which this condition is filled, it can use without a limit especially.

[0014] the gap section between the micro-lens forming face in the refracting interface array substrate 202, and the flat-surface substrate 203 — optical — "an air space or a vacuum layer" — you may also insert in between another ingredient which is good and has an optical refractive index (claim 5). The width of face of the above-mentioned gap is theoretically decided by the optical design "from several micrometers to several 10 micrometers." The above-mentioned gap section is filled with the gestalt of this operation with adhesives 206. The refracting interface array substrate 202 and the flat-surface substrate 203 are unified by junction. If "the ingredient of junction" is an ingredient which can bear the heating temperature processed at a back process, especially a limit will not have it. To the near field of the liquid crystal layer of an opposite substrate, "when heat-treating at a back process", it is desirable the gap section of the refracting interface array substrate 202 and the flat-surface substrate 203 "sandwiches [consider as a vacuum layer or] another ingredient." It is because an air space will expand in the case of heat treatment if the above-mentioned gap section is made into an air space.

[0015] The refracting interface array substrate 202 is shown in drawing 2 . A sign 303 shows the "spacer section." "h" shows the height (from micro-lens 302 forming face) of the spacer section 303, and "h'" shows the height of a micro lens 302. h and h' needs to fill related :h>=h'. That is, the spacer section 303 is formed in the height more than the height of each micro lens 302.

[0016] Drawing 3 shows the "opposite substrate" of the liquid crystal device shown in drawing 1 in explanatory view. In the sign 202, a "refracting interface array substrate" and a sign 303 show the "spacer section", and the sign 350 shows the "array array area" of a refracting interface array (micro-lens array). That is, the array of the micro lens as a refracting interface carries out an array array, and is formed in this array array area 350. The spacer section 303 is formed so that the array array area 305 may be surrounded in "the periphery section of the array array area 305", and it is formed until it results in the "cutting section" shown with a sign 304. "the part which gave the hatch way" shown in drawing 3 by sign 203A — the periphery edge of the flat-surface substrate 203 — "— the beveled part (henceforth a "chamfer") is shown.

[0017] Drawing 4 shows the "condition near the edge" of the opposite substrate shown in drawing 3 . In a sign 206, "adhesives (ingredient of junction)" and sign 203A shows a chamfer, and a sign 304 shows the cutting section (field cut above "an isolation process"). The angle shown in drawing 4 : theta is a "angle of chamfer", and beveling residue:t is "D-d" when "d" sets thickness of "the amount of beveling", and the flat-surface substrate 203 to "D." In drawing 4 , although completely filled by the layer of adhesives 206 between the refracting interface array substrate 202 and the flat-surface substrate 203, as mentioned above, it may use as a vacuum

layer the gap section of a micro-lens forming face and the flat-surface substrate side which counters this, and may also insert adhesives only into the periphery section (spacer section) by it. Although the periphery edge of the flat-surface substrate 203 is beveled as shown in drawing 4 , beveling is performed so that it may leave a part of thickness of the flat-surface substrate 203, and is not performed to the layer of adhesives 206. That is, the layer of adhesives 6 is separated by right-angle" to "light plane of incidence like the end face of the refracting interface array substrate 202 in which the micro-lens array was formed. Although the above-mentioned cutting section 304 accomplishes "the periphery end face of an opposite substrate" as shown in drawing 4 , the periphery section of the spacer section 303 will make "a part of periphery end face of an opposite substrate."

[0018] In the gestalt of the operation explained above namely, an "opposite substrate" In the liquid crystal device for liquid crystal projectors, the liquid crystal layer 205 is pinched with the TFT substrate 201. The refracting interface array substrate 202 which are the opposite substrate arranged at an optical exposure side, and the minute refracting interface 302 with an optical focusing function was made to correspond to each pixel in the TFT substrate 201, and carried out array formation on one side at the shape of an array, It is arranged in the near field in which the array of the refracting interface 302 of this refracting interface array substrate 202 was formed. The black matrix aperture corresponding to the array array of a refracting interface is formed. The refracting interface array substrate 202 and a coefficient of thermal expansion are in abbreviation etc. by carrying out, and it comes to unify the flat-surface substrate 203 by the transparent material. Transparent electrode film 204A is formed in one outside flat surface of the unified substrate. In the periphery section of the array array area 350 of the near field in which the array of the refracting interface of the refracting interface array substrate 202 was formed The spacer section 303 for maintaining the gap of a refracting interface array substrate and a flat-surface substrate so that the magnitude of the above-mentioned gap may become more than the height of the minute refracting interface 302 And it is what the periphery section of the spacer section 303 formed so that a part of periphery end face 304 of an opposite substrate might be made (claim 1). Each refracting interface 302 formed in the refracting interface array substrate is "the micro lens of a convex" (claim 2), and "beveling" is performed to the periphery end face of the flat-surface substrate 203. The flat-surface plate 203 It is arranged at the liquid crystal layer 205 side (claim 4). Between the refracting interface array substrate 202 and the flat-surface substrate 203 They are "the adhesives for junction" which fills the gap part between the refracting interface array substrates 202 and the flat-surface substrates 203 (claims 6 and 7). [in / the transparent medium 206 with a predetermined refractive index is inserted (claim 5), and / in this transparent medium 206 / the array array area 350 of the array of a refracting interface] And the above-mentioned liquid crystal device is a liquid crystal device for liquid crystal projectors which comes to pinch the liquid crystal layer 205 with the opposite substrate like the above, and the TFT substrate 201. As well as this "liquid crystal device", although it can be used for monochrome image display, it can be used as what displays the thing of the arbitration of R (red) for displaying a color picture, G (green), and B (blue) image. That is, the image display means for liquid crystal color projectors can be constituted by displaying R, G, and B image on that each using these three liquid crystal devices.

[0019]

[Example] Hereafter, a concrete example is given. The liquid crystal device based and explained to drawing 1 - drawing 4 was carried out as follows.

[0020] If drawing 3 is referred to, the refracting interface array substrate 202 is the thing of N-neo SERAMU 0 ingredient (refractive-index:nd=1.541 to d line), they are longitudinal direction (longitudinal direction) die-length:27.4mm and lengthwise direction die-length:19.85mm, and array array formation of the micro lens 302 is carried out in "the array array area (longitudinal direction: 18.582mm, lengthwise direction:14.022mm)" shown with a sign 350. The spacer section 303 formed in the periphery section of a service area 350 makes the shape of 4 square shapes, and surrounds a service area 350, and the width of face is 1.2mm. (In the example, although not shown in drawing 3 , as shown in drawing 2 or drawing 4 , "the field of the same height as a lens base" is prepared in the shape of [square] a frame between the array area of a micro lens, and the spacer section, and, for this reason, the width of face of the spacer section is the above-mentioned width of face.)

[0021] The flat-surface substrate 203 is an parallel plate of N-neo SERAMU 0 :60micrometer ingredient in thickness. The layer of the adhesives 206 which join the refracting interface array substrate 202 and the flat-surface substrate 203 fills the gap between both substrates. Adhesives 206 are "the low refractive-index adhesives of a fluorine system." The black matrix 204 of the field of another side of the flat-surface substrate 203 was formed with Cr film, and transparent electrode film 204A was formed with the ITO film. Ally MENTOMA-KU was formed in the periphery section at Cr film surface of the black matrix 204, and it used for alignment with the TFT substrate 201. The above-mentioned "black matrix aperture" which is opening of a black matrix is a

rectangle configuration, it is arranged by "it is in a grid pattern" as a matrix, each aperture is breadth:23.0micrometer and dip:18.5micrometer, array pitches are longitudinal direction pitch:28.5micrometer and lengthwise direction pitch:28.5micrometer, and diagonal lay length is 40.305 micrometers.

[0022] Each of the micro lens 302 which is the "refracting interface" formed in the refracting interface array substrate 202 formed the field (a configuration and a dimension are determined by the dimension and pitch of a pixel in a liquid crystal device) of 4 square-shape configuration as a base configuration. The micro lens 302 which makes an array array is a lens height:8.28micrometer (height of drawing 2 : h') convex lens, it is a spherical-surface configuration near the crowning, and a focal distance is 190 micrometers. Height of the spacer section 303: h (drawing 2) is height:10.30micrometer slightly higher than the top-most vertices of each micro lens 302. The flux of light condensed by the above-mentioned micro lens penetrates a flat-surface substrate, and condenses at the small point of a black matrix part. It beveled to the "periphery end face" which makes the thickness of the flat-surface substrate 203. With the TFT substrate 201, the opposite substrate with such a configuration pinches the liquid crystal layer 205, and is unified as a whole.

[0023] Hereafter, the manufacture approach of the thing opposite substrate in the above-mentioned example is explained. Thickness: The "refracting interface array substrate" for 30 pieces which has the above-mentioned flat-surface dimension (27.4mmx19.85mm) for N-neo SERAMU 0 substrate (1mm and diameter:8 inch) in this substrate as an ingredient for refracting interface array substrates was arranged. That is, first, sputtering of the Cr film is carried out to thickness:5000A on the above-mentioned neo SERAMU N-0 ingredient substrate, by the wet etching using a mask, it leaves only the part applicable to the spacer section (connected with the spacer section of an adjoining refracting interface array substrate), and Cr film is removed. Although formed by the photograph HABURIKE-SHON method, in case a mask forms chromium by sputtering, it may cover and form except the spacer section with a metal mask. Next, a photoresist is applied as a thermoplastic photosensitivity ingredient and it was made for a photoresist to remain for said every 4 square-shape configuration when it becomes the base field of a micro lens in each array array area by patterning. Thus, the array array of the photoresist of an oblong 4 square-shape configuration is acquired for every array array area. Heat deformation of the above-mentioned photoresist was carried out, the front face of each photoresist was "convex surface" Turned, and the lens configuration of a request of height:12.525micrometer was formed. A base configuration is [the cross-section configuration of the configuration at this time] a globular form-like in oblong 4 square shapes.

[0024] Then, 12.7 micrometers is etched by the selection ratio [as a whole] "large more slightly than 1" with the diameter ECR plasma etching system of macrostomia using RIJITA-NOKOIRU of the diameter of macrostomia, the array array of the micro lens of a lens height:9.28micrometer (height of drawing 2 : h') convex is formed in a neo SERAMU N-0 ingredient substrate front face, and over etching of the about 2 micrometers is carried out still more slightly.

[0025] Since the part which should serve as the spacer section remains without being etched in a mask operation of Cr film, if the above-mentioned Cr film is removed after micro-lens array formation, height:h of the spacer section 303 will be set to height:10.30micrometer slightly higher than the top-most vertices of each micro lens 302. All over the field in which a micro-lens array and the spacer section were formed, the low refractive-index adhesives of a fluorine system are applied as adhesives. Thickness it should be thin to a flat-surface substrate from moreover : N-neo SERAMU 0 60-micrometer ingredient (diameter: 8 inch parallel plate) is put. Ultraviolet curing of the above-mentioned adhesives was carried out, and the transparent electrode and black matrix for every opposite substrate were formed in the field of another side of a thickness:60micrometer parallel plate (flat-surface substrate) after that. Since the plane-parallel plate which turns into a refracting interface substrate, and the parallel plate which should turn into a flat-surface substrate are the N-neo SERAMU 0 same ingredients, a coefficient of thermal expansion is equal and there is no problem of destruction by the stress in the case of the heat treatment process in the process for manufacturing TFT-LCD. From this condition, the chip of each opposite substrate is beveled using a dicing machine etc. to isolation and the periphery end face of the flat-surface substrate in each chip subsequently separated. It separates and this problem that "peeling of KAKE, a chipping, and adhesives" generates on the boundary of a part for a cutting surface part (part shown in drawing 4 with a sign 304), and this part and chamfer (part shown in drawing 4 by sign 302A) exists in the case of beveling. In this invention, it has prevented effectively that "KAKE and a chipping" occur in a part for a cutting surface part by making the spacer section into the height more than a refracting interface part, and detaching in this spacer section (physical reinforcement being large because thickness is large). In order to prevent exfoliation of KAKE in a chamfer, a chipping, and adhesives, 45 degrees of abbreviation -, 70 abbreviation, and "thickness:t of beveling residue: drawing 4 " were considered for "the angle of chamfer (include angle which the perpendicular

cutting plane cut on the occasion of separation and a beveling side make: angle:theta in drawing 4)" as 15 micrometers or more of abbreviation. the above -- "-- beveling include-angle: -- theta", -- "-- amount of beveling: -- d" -- "-- beveling residue: -- the result of the experiment which investigated the relation between t", "diamond particle-size (path of diamond grain used for beveling):delta", and "a chipping (generating of KAKE of adhesives is included)" is carried out to a list, and it is shown below.

[0026]

Experiment: 1 Thickness of a flat-surface substrate: D= 60 micrometers theta (degree) d (micrometer) delta Chipping t (micrometer) Criticism ** Particle-size number Amount (micrometer)

1 40 45 400 70 15 xtwo 40 50 400 80 10 xthree 45 40 360 40 20 **4 45 45 360 50 15 **5 45 50 360 70 10 xsix 45 55360 110 5 x745 60360 130 0 x845 40 400 2020 O945 45 400 3015 O 1045 50400 5010 x11 45 55400 80 5 x12 45 60 400 100 0x13 60 35 400 10 25 O14 60 40 400 20 20 O 15 6045 400 30 15 O 16 60 50 400 50 10**17 60 55 40090 5 x18 60 60 400 100 0 x1970 40 400 15 20 O 20 7045 400 20 15 O21 70 50 400 40 10 **22 7055 400 70 5x

Chipping: Include generating of KAKE of adhesives. It carried out by microscope observation. Evaluation: The following three-stage estimated according to the situation of KAKE, a chipping, exfoliation of adhesives, the can of cover glass, etc. by microscope observation. O : -- fitness and **: -- x: generated although it is few -- many occur.

[0027]

Experiment: 2 Thickness of a flat-surface substrate: D= 35 micrometers theta (degree) d (micrometer) delta Chipping t (micrometer) Criticism ** Particle-size number Amount (micrometer)

1 45 15 400 20 25 O 2 45 20 400 30 15 O 3 45 25 400 50 10 xfour 45 30 400 80 5 xfive 60 10 400 20 25 O 6 60 15 400 30 20 O760 20400 40 15 O860 25 400 6010 **960 30 400 100 5 xten 7010 400 20 25O11 7015 40030 20O12 7020 400 35 15O13 70 25 400 -- 6010 **14 70 30 400 90 5 x -- these results show, enlarging beveling residue:t (15 micrometers or more) and that it is good to make an angle of chamfer into the range of 45 - 70 degrees. In addition, if the beveling residue of a flat-surface substrate is enlarged too much, the burden to the cutting blade at the time of full cutting will become large, and the chipping more than the amount of beveling will occur. Therefore, the beveling residue needed to be controlled according to the ingredient of a flat-surface substrate, and the parallel monotonous thickness which changes, and the beveling residue needed to be set to 150 micrometers or less when the thickness of a flat-surface substrate was 250 micrometers.

[0028] As mentioned above, since the height of the spacer section was high compared with the height of a micro lens, the refracting interface array substrate and the flat-surface substrate contacted in the spacer section, and detached by making the spacer section into the cutting section, a chamfer did not result in the layer of adhesives, they were large in beveling residue:t, and wrote the beveling include angle to 70 abbreviation [45 -], and the exfoliation of the layer of adhesives of them was lost [there are few amounts of chippings and]. Mechanical strength with the sufficient opposite substrate manufactured by the above-mentioned approach was obtained.

[0029] When the liquid crystal layer was pinched with the TFT substrate manufactured separately and the opposite substrate obtained as mentioned above, the liquid crystal device (TFT-LCD) was formed and the exposure flux of light (parallel flux of light) was irradiated in incident angle:0**8.6 degree, 63.2% or more of efficiency for light utilization was realizable. Efficiency for light utilization when not using a refracting interface: Efficiency for light utilization improved to a 1.31 times as many abbreviation as this to 48.12%.

[0030]

[Effect of the Invention] As explained above, according to this invention, the new opposite substrate the new liquid crystal device for liquid crystal projectors and for liquid crystal devices is realizable. Since the counterelectrode of this invention has composition like the above, in the case of isolation of the chip in the manufacture process of an opposite substrate, can mitigate generating of peeling of the layer of KAKE, a crack, and adhesives effectively, therefore the yield of an opposite substrate can improve, the productivity and the dependability of a counterelectrode are made to be able to improve, and the production cost of a correspondence substrate can be reduced. By being constituted using the opposite substrate like the above, the liquid crystal device of this invention can be manufactured cheaply, and, moreover, is reliable.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing for explaining one gestalt of operation of the liquid crystal device for the liquid crystal projectors of this invention.
[Drawing 2] It is drawing for explaining the refracting interface array substrate in the gestalt of the above-mentioned implementation.
[Drawing 3] It is the explanatory view like a top view of the opposite substrate in the gestalt of the above-mentioned implementation.
[Drawing 4] It is an III-III' sectional view in drawing 3 .
[Description of Notations]
202 Refracting Interface Array Substrate
203 Flat-Surface Substrate
302 Micro Lens
303 Spacer Section
206 Adhesives

[Translation done.]